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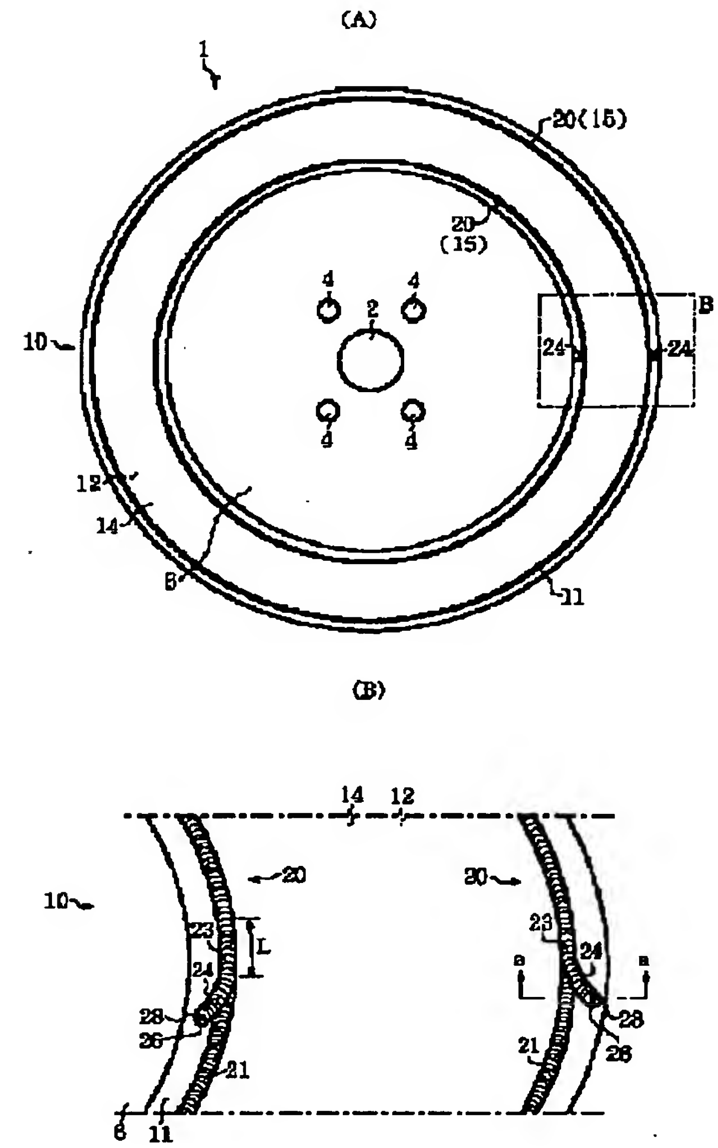

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APPLICANT : NIPPON LIGHT METAL CO LTD;

INVENTOR : ISHIKAWA HIROMITSU;

INT.CL. : B23K 20/12 F16F 15/173 // B23K101:12

TITLE : ANNULAR WELDING METHOD AND HERMETICALLY SEALED CONTAINER AND VISCOUS DAMPER TO BE OBTAINED BY THE METHOD

ABSTRACT : PROBLEM TO BE SOLVED: To provide the annular welding method by which the hermetically sealed container such as as the viscous damper can be surely hermetically sealed with prescribed welding strength by using friction-stirr-welding and the hermetically sealed container to be obtained by the method.

SOLUTION: A ring shape lid plate 14 is inserted into the opening part of a ring shape recessed groove 12 in an annular container 10. Along respective circular butter parts 15 which are double on the inside and outside and are formed between the inner and outer peripheries of the lid plate 14 and opening edges on the inside and outside of the container 10, the annular friction-stirr-welding is performed respectively by a tool having stirring pin and surface pressing-down part, and respective circular weld lines 20 which are double on the inside and outside by welding, are formed. Further, after forming overlapped parts 23 in the weld lines 20, the deviated parts 24 of the weld lines 20 and the toe of weld 26 at the tips of the deviated parts 24, are positioned by shifting them to the surface outside or inside from the outer and inner opening edges of the container 10. This hermetically sealed container 10 obtained by the annular welding method is used for the viscous damper 1, etc.

June 3, 1941. W. RASKIN 2,244,475

EVAPORATOR PLATE FOR REFRIGERATED CABINETS

Filed March 29, 1938

Fig. 1.

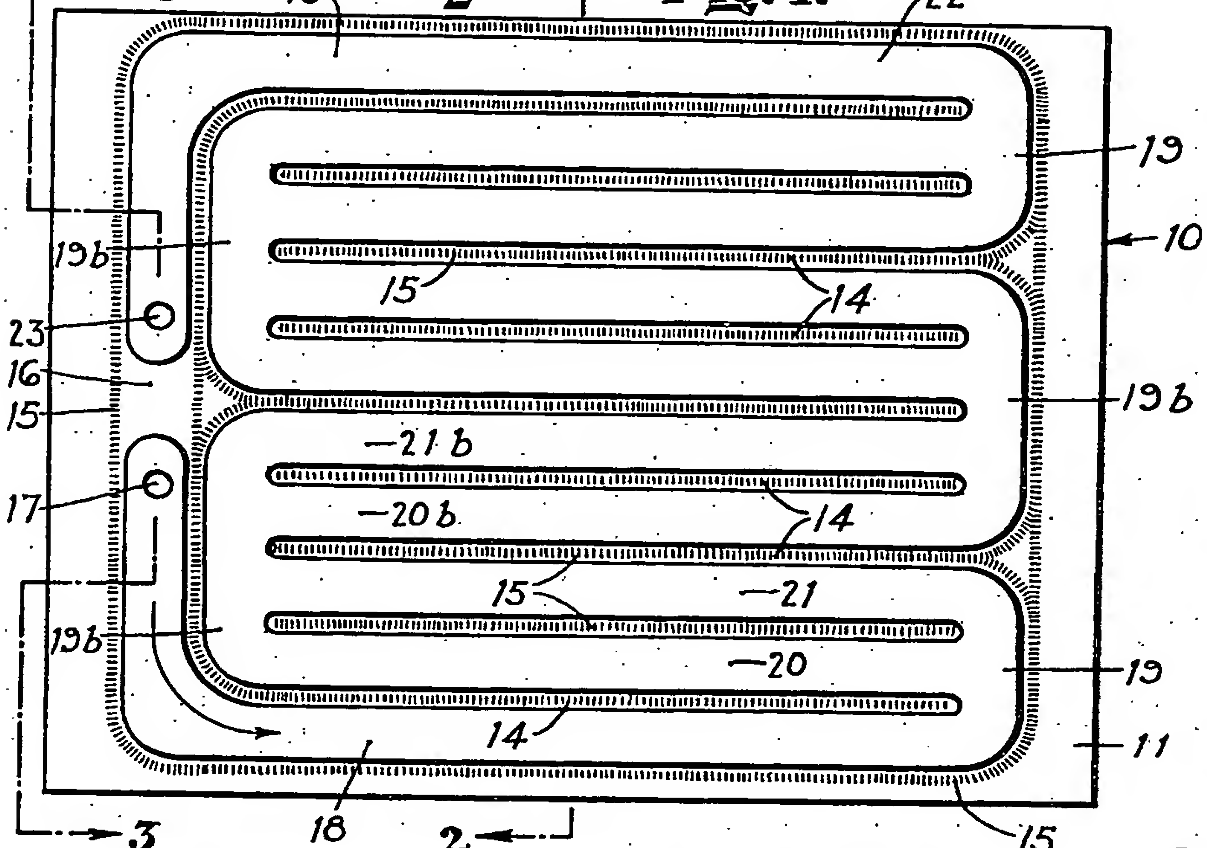

Fig. 2.

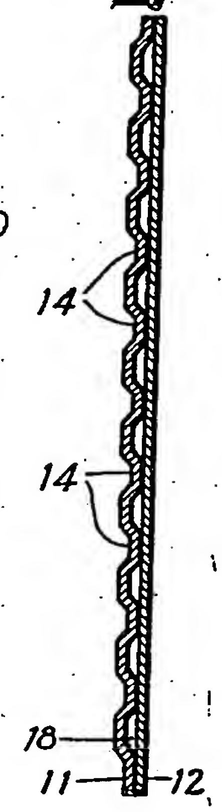

Fig. 4.

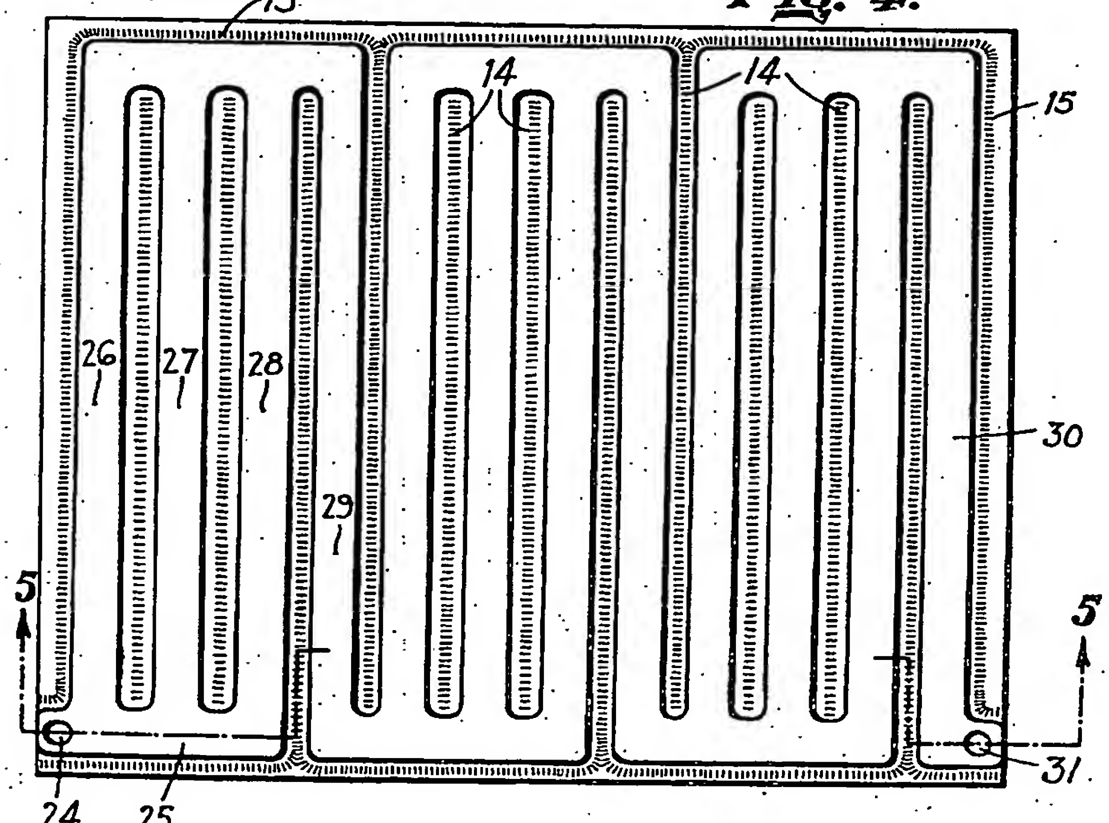

Fig. 3.

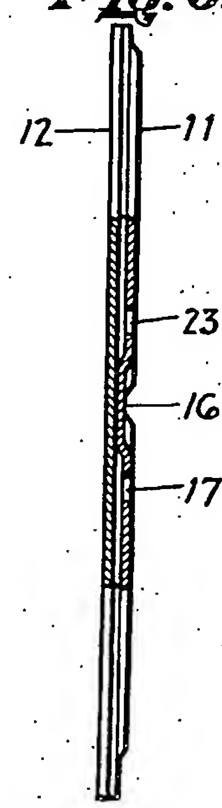

Fig. 5.

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UNITED STATES PATENT OFFICE

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EVAPORATOR PLATE FOR REFRIGERATED CABINETS

Walter Raskin, New York, N. Y.

Application March 29, 1938, Serial No. 198,715

4 Claims. (Cl. 62—126)

This invention relates to heat exchangers and the like and, more particularly, to an improved evaporator plate of the so-called dry-type for refrigerated storage cabinets such as are commonly used in soda fountains and cabinets for the storage and dispensation of ice-cream and frosted foods, etc.

One of the principal objects of the invention is to provide a heat exchanger, or an evaporator plate of the character indicated, having increased refrigerating efficiency by reason of an increased heat absorption and reduced pressure drop between the inlet and outlet.

Another object is to provide an evaporator plate in which the heat absorption is substantially uniform throughout the plate and in which thorough flooding is insured at all times.

Still a further object is to provide an evaporator plate of the character indicated in which the time required for the pull-down to the desired temperature is reduced and which will result in a considerable saving of current.

As is disclosed in my co-pending application, Serial No. 105,869, filed October 16, 1936, I have found that by forcing the refrigerant liquid through the plate in a guided directional flow, most of the disadvantages connected with the old-type plate have been eliminated. The present invention now contemplates an improvement over the construction disclosed in said application and of which the present one is a continuation in part.

For the purpose of making the invention more comprehensible, the following preliminary introduction is deemed desirable. The efficiency of the plate depends largely on the degree of flooding. If portions of the plate become starved during the feeding operation, naturally the available surface will be reduced. Thus the time required for the pull-down to the desired temperature will be increased with a resultant waste of current. It will also be understood that a liquid will take the course of least resistance and thus, unless the current is forced through the plate in a guided directional flow, it will approach a straight line.

Furthermore, when the liquid is forced through the ducts, it will become subjected to considerable friction, the force of which stands in direct relationship to the mass, the cross-section of the ducts and the distance to be travelled. Thus, even if the evaporator or the evaporator ducts are completely flooded, the friction will still cause a pressure drop between the inlet and the outlet. The pressure drop, in return, results in decreased heat absorption and, since the pressure drop between the inlet and the outlet of each plate is multiplied by the number of plates used in the system, the drop between the terminals thereof will become considerable.

As previously indicated, this pressure drop, in turn, causes a drop in temperature and thus, while the desired temperature may be attained at the inlet or in the first plate, it will drop gradually towards the end of the flow. It has been found that in a 12-hole system storing 60 gallons of ice cream, the pressure drop is between 5″ to 6″ when a temperature of −10° F. is desired. This pressure drop can easily be translated into a temperature drop by standard tables and, according to these tables, a pressure drop of 5″ vacuum, when sulphur-dioxide is used as the refrigerant, will result in a temperature drop of 10° F. Thus, if a temperature of approximately −10° F. is attained adjacent the inlet, the temperature at the outlet of the system will become approximately −20° F. The temperature drop is, of course, dependent greatly upon the type of refrigerant used and, also, upon the pressure at which it is originally introduced into the system. The above figures apply to sulphur-dioxide introduced into the system at a pressure of 13.9″ vacuum, corresponding to a temperature of −10° F.

With these phenomena in mind, the present invention has been designed with a view to reducing the pressure drop between the inlet and the outlet of the evaporator plate and between the terminals of the system without impairing the efficiency of the plate. Thus I have found that by using the instant invention, under conditions identical with the ones described, the pressure drop is only 1.5″ vacuum and which would correspond to a temperature drop of only 3°.

This purpose of the invention may be accomplished by breaking up the current and successively restricting it and expanding it. In this manner, not only complete flooding of the evaporator ducts will be insured but also the evaporator surface will be increased to a maximum and the friction reduced to a minimum.

Attempts have been made to accomplish this result by other means; so, for instance, plates have been made in which the refrigerant current is directed in a sinuous flow across the plate. To counteract the ever-increasing force of the friction during the course of the flow, however, the end portions of the system have to be intentionally starved in order that the temperature may be balanced. In this manner, it will be under-

stood that the efficiency of the plate is impaired resulting in a waste of current.

In other constructions, attempts have been made to reduce the friction by conducting the refrigerant through a plurality of parallel ducts. It will be understood, however, that unless the various ducts are completely flooded the efficiency of the plate will be impaired. As stated, the tendency is for the liquid to take the course of least resistance and, thus, only those ducts adjacent the intake and the outlet will be flooded. To counteract this tendency, attempts have been made to provide a header of relatively large cross-section in comparison with the cross-section of the ducts and which interconnects the several ducts at their respective ends. According to this principle, the header is supposed to become flooded first since its resistance is less than that of the narrow ducts, and the latter will then be fed from the header. Experience has shown, however, that such construction does not, by any means, insure complete flooding of the plate.

The present invention has been constructed along the foregoing principles; namely, to reduce the friction and to insure complete flooding, but eliminates the objections connected therewith and it will be more readily understood when taken in conjunction with the accompanying drawing in which:

Figure 1 is a front elevation of an evaporator plate according to the invention;

Figure 2 is a section along the line 2—2 of Figure 1;

Figure 3 is a partial section along the line 3—3 of Figure 1;

Figure 4 is a front elevation of a modification; and,

Figure 5 is a section along the line 5—5 of Figure 4.

The evaporator plate, generally indicated at 10, comprises two superimposed metal sheets 11 and 12, preferably of rectangular shape. The sheet 11 is embossed to form a continuous sinuous corrugation 13, while sheet 12 is flat. The two sheets are welded together by seam welding or spot welding along the flat portions 14 between corrugation 13 and along the edges of the sheet. In the plate illustrated in the drawing, the seam welding process has been employed and the seams formed thereby are indicated by the reference numeral 15.

A continuous sinuous passage for the refrigerant will thus be formed, which will hereinafter be described in greater detail. This passage will act as an expansion chamber for the liquid or vaporized refrigerant.

The outer edges of the sheet 11 and the portion 16 between the two terminals of the corrugation are also embossed to correspond with the flat portions between the corrugations and preferably welded to the flat sheet 12. In this manner, leakage or escape of the refrigerant will be prevented.

As previously stated, the invention contemplates a reduction of the frictional force as well as complete flooding of a maximum area of the evaporators. The invention described in my co-pending application has partly attained this goal, but I have found that the diagonally running ducts, despite the improvement over the prior constructions, still offer considerable resistance. I have now established that by combining the sinuous passage-way or expansion chamber with the features of the straight parallel ducts, still better results can be obtained. Thus, in terms of broad inclusion, the invention contemplates an evaporator plate having an expansion chamber comprising the combination of a continuous sinuous passage-way with parallel straight ducts which divide each convolution into a plurality of parts. Such a construction successively restricts and expands the refrigerant, the result of which will be not only reduced friction but also a complete flooding of the passageway.

Referring to Figure 1 of the drawing, the refrigerant, such as sulphur-dioxide, isobutane, or methyl chloride, ammonia, Freon, etc., is introduced into the expansion chamber through the inlet opening 17 by means of an expansion valve of conventional construction. This valve is not shown in the drawing since it does not form part of the invention. The current runs in the direction of the arrow into the inlet duct 18 of the first convolution of the passageway. The "bight" 19 of the first and last convolution is divided into two parallel straight ducts 20 and 21 by the seam welding 15 along the flat portions 14, whereas the intermediate "bights" 19b have additional ducts 20b and 21b. Thus, as soon as the current reaches the "bight" of each convolution, it will be divided into two parts. This division causes successive restriction and expansion of the refrigerant and results in reduction of the resistance. It also causes the expansion chamber to become flooded more rapidly and the sinuous form of the passageway provides a maximum evaporator surface. In view thereof the time required for the desired pull-down will be greatly reduced.

The expansion chamber is preferably fed from below in order to take advantage of the centrifugal force to insure a complete flooding of the ducts.

After the current has passed the last convolution, it passes through the outlet duct 22 to the outlet opening 23. It may then be conducted to other plates of the system which are flooded in a similar manner.

It will be understood that the number of parallel ducts in each convolution or the number of convolutions may be selected according to practical demands. If the current is led horizontally across the plate as shown in Figure 1, I have found that two ducts for each convolution is most suitable. On the other hand, when the current is vertical it may be desirable in certain circumstances to divide each convolution into three parallel ducts.

The illustration in Figure 4 shows an embodiment of this latter modification. The refrigerant is introduced through the inlet opening 24 directly into the "bight" 25 and thus the vertical ducts 26, 27 and 28 are flooded simultaneously. The current then passes down the companion passage 29 to the "bight" of the next convolution which is flooded in a similar manner. The current finally passes down the outlet duct 30 to the outlet opening 31 from which it may be conducted to other plates of the system.

It will be understood that the above detailed description is merely illustrative of the inventor's concept and different embodiments may be made without departing from the spirit thereof.

What is claimed is:

1. In an evaporator plate for refrigerating systems, means for providing a sinuous, continuous passage extending over said plate forming a plurality of merging, alternately reversed U-shaped

elements having conduits therein, at least one of the legs of said U-shaped elements being enlarged and the conduits therein being divided into a plurality of parallel ducts terminating in the bend of the respective U-shaped element, said bend being restricted in width with respect to said enlarged leg, whereby the flow of the refrigerant will be successively restricted and expanded to vary the turbulence of the current in said passage.

2. In an evaporator plate for refrigerating systems, means providing a sinuous passage extending over said plate forming a plurality of merging, alternately reversed U-shaped elements having conduits therein, the legs of said U-shaped elements alternately being widened and the conduits therein being divided into a plurality of parallel ducts terminating in the bend of the respective U-shaped element, said bends having substantially the same width as said ducts, whereby the flow of the refrigerant will be successively restricted and expanded to vary the turbulence of the current in said passage.

3. In an evaporator plate for refrigerating systems comprising two superimposed metal sheets, at least one of said sheets being provided with a sinuous, continuous depression extending over said sheet forming a plurality of merging, alternately reversed U-shaped elements forming a conduit, a plurality of additional parallel depressions in at least one of the legs of said U-shaped elements also forming conduits and terminating in the bends, said bends having substantially the same width as said depressions, whereby the flow of the refrigerant will be successively restricted and expanded to vary the turbulence of the current in said passage.

4. In an evaporator plate for refrigerating systems, means for providing a sinuous, continuous passage extending over said plate forming a plurality of merging, alternately reversed U-shaped elements having conduits therein, at least one of the legs of said U-shaped elements being enlarged and the bend being restricted in width with respect to said enlarged leg, whereby the flow of the refrigerant will be successively restricted and expanded to vary the turbulence of the current in said passage.

WALTER RASKIN.